

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-094084

(43)Date of publication of application : 06.04.2001

(51)Int.Cl.

H01L 27/14  
H04N 5/335  
H04N 9/07

(21)Application number : 11-265153

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(22)Date of filing : 20.09.1999

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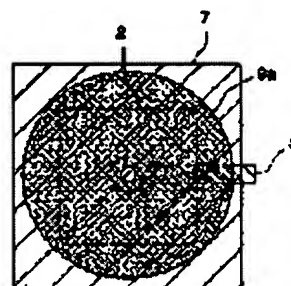
## (54) SOLID STATE COLOR IMAGING DEVICE

(57)Abstract:

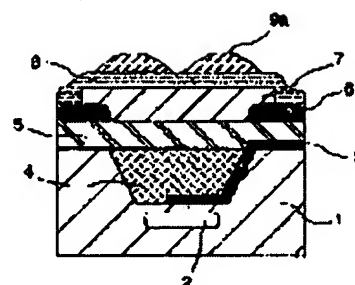
PROBLEM TO BE SOLVED: To obtain a solid state color imaging device comprising a color filter and a convex lens formed for the light receiving element in the sensor in which photosensitivity can be enhanced without causing any trouble even in case of a solid state imaging device where a light shielding layer is present partially on the central plane of the light receiving element.

SOLUTION: A ring type convex lens is provided on a light receiving element in order to avoid condensation of light onto a light shielding layer present in the center of the light receiving element.

(a)



(b)



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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[Date of requesting appeal against examiner's  
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[Date of extinction of right]

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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開

特開2001-9

(P2001-94)

(43) 公開日 平成13年4月6

(51) Int. Cl. <sup>7</sup>	識別記号	F I	ターム
H 0 1 L 27/14		H 0 4 N 5/335	V 4
H 0 4 N 5/335		9/07	A 5
9/07		H 0 1 L 27/14	D 5

審査請求 未請求 請求項の数 1 O L

(21) 出願番号 特願平11-285153

(22) 出願日 平成11年9月20日(1999.9.20)

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Fターム(参考) 4M118 AA01 AA05 AB01 B/

FA06 GB07 GC08 GI

GD07

5C024 AA01 CA12 DA01 E/

FA01 FA19 GA11

5C065 BB48 CC01 DD03 DI

EE06 EE11

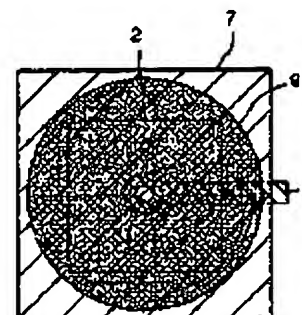
(54) 【発明の名称】 カラー固体撮像素子

(57) 【要約】

【課題】 固体撮像素子の受光素子に対して、少なくともカラーフィルタおよび凸レンズ体を形成したカラー固体撮像素子において、受光素子中央面に遮光性の電極層が部分的に存在している種類の固体撮像素子であっても、不具合を生ぜず光感度の向上が図れるカラー固体撮像素子を提供すること。

【解決手段】 受光素子の中央部に存する遮光性の電極層への景光を避けるようにリング状の凸レンズ体を受光素子の上に設けること。

(a)



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生ぜず光感度の向上が図れるカラー固体  
 することにある。

[ 0 0 0 7 ]

【課題を解決するための手段】本発明は、  
の受光素子に対して、少なくともカラー  
凸レンズ体を形成したカラー固体線像素  
光素子の中央部に存する遮光性の凹部層  
るようにリング状の凸レンズ体を受光素  
子を特徴とするカラー固体線像素子で、

【0008】

【発明の要旨の形態】本発明の要旨の形態は、  
実施例と共に説明する。本発明のカラー

は、図1 (a) および (b) に示すように、シリコン基体1と、このシリコン基体1上に配設された複数の受光素子2と、中央部およびそこから画素領域の外部に延びる配線3と、上記シリコン基体1上および電極層4に設けられた透明な下部平滑化層5と、この下部平滑化層5上かつ各受光素子部の間隙部に対応する部位に設けられた、黒色染料で染色された被染色体からなるブラックマトリクス6と、同じく下部平滑化層5上かつ各受光素子部に対応する部位に設けられた、赤(R)、緑(G)、青(B)のカラーフィルタ層7と、このカラーフィルタ層7上かつブラックマトリクス6とカラーフィルタ層7上を覆う透明なオーバーコート層8と、このオーバーコート層8上に、受光素子の中央部に存する遮光性の凸部9を避けるように設けられたリング状の凸部10とでその主要部が構成されている。なお、上記凸部9を見やすくするためにブラックマトリクス6に設けられている。

【０００９】なお、上記構成のうち、下記に示すように、受光素子２が設けられた部分に、シリコン基体１の凹部を埋めるように、導電性材料を設けることも行われる場合がある。

【0010】そして、この構成のカラー形成には、以下の手順を以て行われた。1 内にマトリクス状に複数の受光素子2を例えば約10μm角ピッチで形成し、形成2中央部から画素領域の外部にまで延在アルミニウムにて配設した。

【0005】しかしながら、ある種の固体撮像素子の受光素子には、素子中央面に遮光性の覆層層が部分的に存

(3)

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した後、カラーフィルタ層7を顔料分散着色感光性レジストにて従来法により厚さ1.0～1.4 $\mu\text{m}$ に、赤、緑、青の各色を順次繰り返して形成した。その上から、透明なオーバーコート層8を従来法に従って形成した。なお、カラーフィルタ層7の形成には、ほかに染色法なども用いることができる。

【0014】次に、上記オーバーコート層8上に、ジェイエスアール（株）製感光性樹脂材料「MFR345」を用い、各受光素子2の位置に相当する部位の上部に、且つ受光素子の中央部に存する遮光性の電極層の端部への集光を避けるようなリング状の形態のパターンを形成するように、パターンマスクを用いて露光時間190msec、硬膜焼成は200℃、180secの条件でパターン形成し、リング状の凸レンズ体9aを得た。この焼成の過程で、パターン化された各リング状形成体の断面形状がなだらかな山形となり、結果として集光機能を持ったリング状の凸レンズ体となった。なお、この凸レンズ体9aの頂点までの高さ（膜厚）は約1.5 $\mu\text{m}$ であった。

【0015】

【発明の効果】受光素子中央面に遮光性の電極層が部分的に存在している種類の固体撮像素子にあっても、上記のような形状の凸レンズ体をカラーフィルタ上に持った固体撮像素子は、入射光が受光素子中央面の遮光性の電極\*

\*極層に集光することによる不具合を生ず、度の向上が図れる。また、入射光の大部分が画素内の受光素子部に集光され、該当画素への光漏れ（クロストーク）が低減する、止される効果もある。

【0016】

【図面の簡単な説明】

【図1】（a）は、本発明のカラー固体撮像素子の平面図、（b）は、同断面図である。

10 【図2】従来のカラー固体撮像素子の一例である。

【図3】従来のカラー固体撮像素子の一例である。

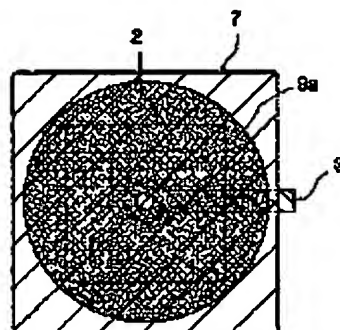
【符号の説明】

- |       |           |
|-------|-----------|
| 1     | シリコン基体    |
| 2     | 受光素子      |
| 3     | 電極層       |
| 4     | 充填層       |
| 5     | 下部平滑化層    |
| 20 6  | ブラックマトリクス |
| 7     | カラーフィルタ層  |
| 8     | オーバーコート層  |
| 9, 9a | 凸レンズ体     |

【図1】

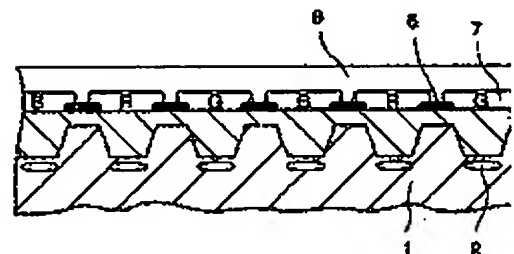
【図2】

(a)



(b)

9a



【図3】



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the color solid state image sensor (charge-coupled device: CCD) built in a color video camera etc.

[0002]

[Description of the Prior Art] Form a color filter on the wafer in which the circuit of a solid state image sensor before cutting for the chip according to individual was formed, in case a color solid state image sensor is manufactured, cut down the chip of the color solid state image sensor according to individual for formation of a color color-separation filter after that, and the member which formed the circumference circuit suitably is made to embed and carry out electrical connection to it conventionally, and it is considering as the finished product. Edge-strip layers other than a color color-separation filter are also respectively formed in the state of the shape of a wafer.

[0003] As this kind of a color solid state image sensor, as shown in drawing 2 R> 2, that by which that principal part is constituted from two or more photo detectors 2 laid underground in the bases 1, such as silicon, and green [ which were prepared in the optical incidence side of each photo detector 2 / the red and green ], and the blue color filter layer 7 is known. Moreover, the technique of carrying out flattening of the front face by forming the lower smoothing layer 5 which consisted of transparent materials before formation of the black matrix 6 prepared in the part corresponding to the gap section of a photo detector 2 and the color filter layer 7, and improving those configurations is also used.

[0004] As a technical problem on the quality required of a color solid state image sensor here, there are improvement in photosensitivity and prevention of a cross talk. For this reason, as shown in drawing 3 , a convex lens-like member (convex lens object 9 group) is prepared through the overcoat layer 8 which consisted of transparence resin on a color filter, and it usually succeeds in the device which condenses and carries out incidence of the image light of the external world to the photo detector 2 on a solid state image sensor. Thereby, improvement in photosensitivity is attained.

[0005] However, if there were some to which the electrode layer of protection-from-light nature exists in component midplane partially in the photo detector of a certain kind of solid state image sensor and the above-mentioned conventional convex lens object was prepared on a color filter in this case, since incident light would concentrate on this protection-from-light nature electrode layer, the gestalt which combined a conventional color filter and a conventional convex lens object was not employable.

[0006]

[Problem(s) to be Solved by the Invention] The place which it is accomplished in order that this invention may solve the above-mentioned trouble, and is made into the technical problem is to offer the color solid state image sensor which does not produce the above-mentioned fault but can aim at improvement in photosensitivity, adopting a color filter convex lens object, even if it is in the solid state image sensor of a class with which the electrode layer of protection-from-light nature exists in photo detector midplane partially.

[0007]

[Means for Solving the Problem] This invention is a color solid state image sensor characterized by preparing a ring-like convex lens object on a photo detector so that condensing to the electrode layer of the protection-from-light nature which consists in the center section of the photo detector may be avoided to the photo detector of a solid state image sensor in the color solid state image sensor which formed the color filter and the convex lens object at least.

[0008]

[Embodiment of the Invention] The gestalt of operation of this invention is explained with one example below. As the color solid state image sensor of this invention is shown in drawing 1 (a) and (b) Two or more photo detectors 2 arranged in the shape of a matrix in the silicon base 1 and this silicon base 1 at least, The electrode layer 3 which extends in the exterior of a pixel field from this photo detector 2 center section and there, The transparent lower smoothing layer 5 prepared on the above-mentioned silicon base 1 and the electrode layer 3, On this lower smoothing layer 5, and the black matrix 6 of the shape of a grid which consists of a chromosome-ed dyed with the black color prepared in the part corresponding to the gap section of each photo detector section, Similarly on the lower smoothing layer 5, and green [ which were prepared in the part corresponding to each photo detector section / the red and green ], and the blue (R, G, B) color filter layer 7, These black matrix 6 and the transparent overcoat layer 8 prepared on the color filter layer 7, That principal part consists of convex lens object 9a of the shape of a ring established on this overcoat layer 8 so that condensing to the electrode layer of the protection-from-light nature which consists in the center section of the photo detector might be avoided. In addition, in drawing 1 (a), in order to make it legible, the black matrix 6 etc. is omitted.

[0009] In addition, before forming the lower smoothing layer 5 among the above-mentioned configurations, forming a packed bed 4 may also be performed so that the crevice of the silicon base 1 which exists around the part in which the photo detector 2 was formed may be filled.

[0010] and the procedure of the following [ formation / of the color solid state image sensor of this configuration ] -- with, it was carried out. The electrode layer 3 which forms by about 10-micrometer angular pitch, and extends even from photo detector 2 formed center section to the exterior of a pixel field was arranged for two or more photo detectors 2 with aluminum with the conventional method in the silicon base 1 at the shape of a matrix.

[0011] Subsequently, using the photosensitive acrylic resin made from Fuji Chemical "FVR-10G", pattern exposure for 15 seconds was performed by 20 mW/cm<sup>2</sup>, and the packed bed 4 was formed in 2.5 micrometers in thickness so that the crevice around a part where the photo detector 2 is formed in the silicon base 1 might be buried.

[0012] Furthermore, the lower smoothing layer 5 was formed in 2.0 micrometers in thickness on the same conditions by complete exposure using the above-mentioned packed bed 4 and this ingredient from on the above-mentioned packed bed 4.

[0013] Subsequently, after carrying out patterning of the chromosome-ed and dyeing and forming the grid-like black matrix 6 with a black color, in the pigment-content powder coloring photosensitivity resist, each color of red, green, and blue was successively repeated in thickness of 1.0-1.4 micrometers with the conventional method, and the color filter layer 7 was formed. Moreover, the transparent overcoat layer 8 was formed according to the conventional method. In addition, a staining technique etc. can be elsewhere used for formation of the color filter layer 7.

[0014] Next, the photopolymer ingredient made from JIEI S R "MFR345" is used on the above-mentioned overcoat layer 8. the upper part of the part equivalent to the location of each photo detector 2 -- and so that the pattern of the gestalt of the shape of a ring which avoids condensing to the edge of the electrode layer of the protection-from-light nature which consists in the center section of the photo detector may be formed Using the pattern mask, pattern formation of exposure-time 190msec and the dura mater baking was carried out on condition that 200 degrees C and 180sec, and they obtained ring-like convex lens object 9a. In process of this baking, the cross-section configuration of each patternized ring-like organizer became gently-sloping Yamagata, and became the convex lens object of the shape of a ring which had a condensing function as a result. In addition, the height (thickness) to the top-most vertices of this convex lens object 9a was about 1.5 micrometers.

[0015]

[Effect of the Invention] Even if it is in the solid state image sensor of a class with which the electrode layer of protection-from-light nature exists in photo detector midplane partially, the solid state image sensor which had the convex lens object of the above configurations on the color filter can aim at improvement in photosensitivity, without producing the fault by incident light condensing in the electrode layer of the protection-from-light nature of photo detector midplane. Moreover, in order that most incident light may be efficiently condensed by the photo detector section in an applicable pixel and the optical leakage (cross talk) by parts other than an applicable pixel may decrease, it is effective in color mixture being prevented.

[0016]

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[Translation done.]



## \* NOTICES \*

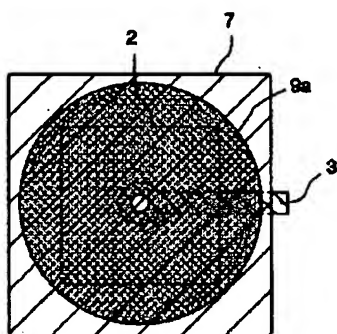
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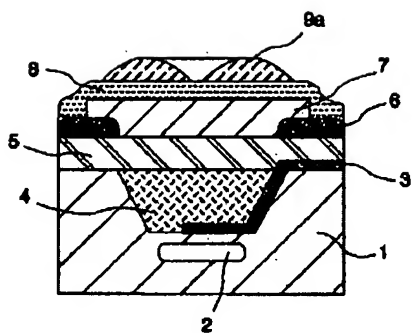
## DRAWINGS

[Drawing 1]

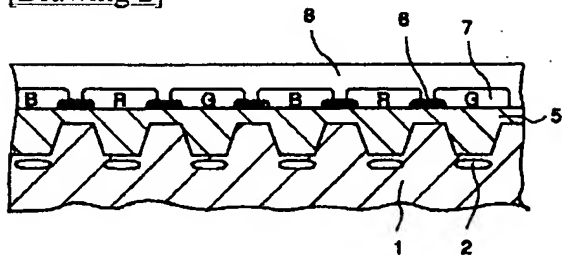
(a)



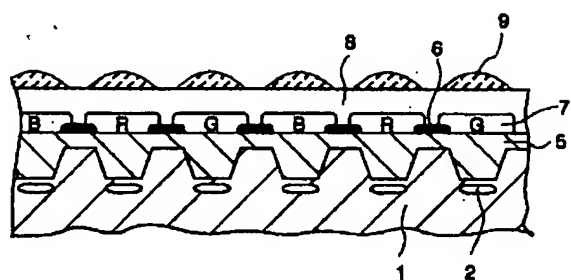
(b)



[Drawing 2]



[Drawing 3]



[Translation done.]